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FINAL REPORT
ON THE

LARGE SCALE APPROACHES TO INVESTIGATING PINYON MORTALITY IN SOUTHWEST COLORADO

Final Report For Cooperative Agreement No. RMS-98103-CA

SAMUEL F. HARRISON AND WILLIAM R. JACOBI

DEPARTMENT OF BIOAGRICULTURAL SCIENCES AND PEST MANAGEMENT, COLORADO STATE UNIVERSITY, FORT COLLINS, CO

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Large Scale Spatial Approaches to Investigating Pinyon Mortality in Southwest Colorado

Samuel F. Harrison and William B. Jacobi
Colorado State University, Fort Collins CO

Abstract: A study was begun in 1997 in order to examine patterns of mortality of pinyon pine (*Pinus edulis*) due to various agents, most notably black stain root disease (*Leptographium wageneri*), Ips bark beetles (*Ips sp.*) and human perturbation of the environment by means of road building, home construction, and recreational use. This study was undertaken using both conventional forest sampling techniques, and also remote sensing techniques, including aerial photography and geographic information systems (GIS). Mortality was sampled for two areas in southwest Colorado, totaling approximately 115 square miles in size. Along each of 50 transects, all pinyon mortality was recorded, and periodic plots were established to record the characteristics of both live and killed trees, as well as other underlying site characteristics such as topography, vegetative cover, and sources of anthropogenic disturbance. Analysis of the data suggests that incidence of mortality is highest in pinyon stands characterized by high densities of small diameter trees with below average amounts of non-pinyon vegetative cover. Relationships between mortality and topography were inconclusive, as were relationships between mortality and site disturbance by humans. At the same time, infrared aerial photography at the 1:6000 scale was obtained for both areas. These photographs were manually interpreted to detect all recognizable pinyon mortality on the landscape. Interpreted images are being converted to GIS coverages for the purpose of spatial autocorrelation analysis between pinyon mortality and underlying site factors such as slope, aspect, elevation, soil type, vegetative cover, and land use. When completed, the study will provide a model for pinyon mortality in the region, as well as a much-needed comparison of the accuracy and utility of technology-based sampling and analysis, as opposed to conventional sampling, of patterns of forest disease.

The following is a synopsis of the project.

Project Objectives: To: 1) produce a GIS-based landscape scale prediction system for incidence of pinyon mortality from Ips bark beetles and black stain root disease in Southwest Colorado and 2) determine the impact of the mortality on the pinyon/juniper plant communities. The general principles of the hazard-rating model will be applicable, with local modifications, to pinyon/juniper forests throughout the Intermountain West.

Project Description: Using aerial photography and site visits by field personnel, mortality centers in pinyon pine forests located in the San Juan National Forest and the Southern Ute Reservation in Colorado will be identified and entered into a GIS database along with soil and site characteristics and locations of disturbed areas. Analyzing the data using spatial statistics, a hazard rating system will be developed for pinyon mortality in the Southwest. Mortality centers will be assessed in detail to determine their size, rapidity of mortality, impacts on regeneration and vegetation diversity.

Justification: The hazard-rating system will enable managers of public forests, National Parks and Monuments, state and county lands, and private holdings to identify high risk areas for pinyon mortality and to thereby implement practices to reduce the damage caused by the disease.

It will also enable land managers to better determine the most appropriate land management emphasis for a given area and aid in the development of Forest Plans. Pinyon mortality has become a major problem in pinyon/juniper forests of the Intermountain West. It creates areas of mortality, which affect wildlife and biodiversity as well as detract from the value of forested land for recreational and aesthetic purposes. We have two primary mortality agents (black stain and Ips bark beetles) working at different rates and possibly different locations and forest conditions. Both organisms create many dead trees that greatly increase the risk of wild fires. Currently, no tools exist to provide managers with information regarding which areas are at risk.

Urgency:

Reports of pinyon dying in unprecedented numbers has made pinyon mortality one of the top priorities for the Forest Health Management Service Center in Gunnison. Forest Health personnel in Utah, Arizona, and New Mexico has voiced similar concerns. Continued high mortality of pinyon could potentially shift the species composition of these forests towards juniper only. Dramatic increases in use of pinyon/juniper woodlands for housing and recreation in recent years has turned this problem into a regional issue. Interest in the project has been sufficiently great that several agencies at the local, state and federal level have funded the first year of field work in order to get the project started as soon as possible. Those contributing in 1998 were Colorado State Forest Service, San Juan National Forest, BIA, Forest Health Monitoring, and Colorado State University.

Work Completed

1. Gather existing data. Published literature, soil and vegetation maps, disturbance data, meteorological data, and other spatial data existing for the San Juan National Forest, Southern Ute Reservation and surrounding areas has been compiled. These areas were used because there was available GIS data on a variety of parameters.

2. Obtain aerial photos. During the summer of 1998, infrared photographs were taken of areas on the San Juan National Forest and the Southern Ute Reservation totaling 110 square miles in area. The photos are at a scale of 1:6000, which allows us easily to pick out areas of mortality in most cases to the single tree level.

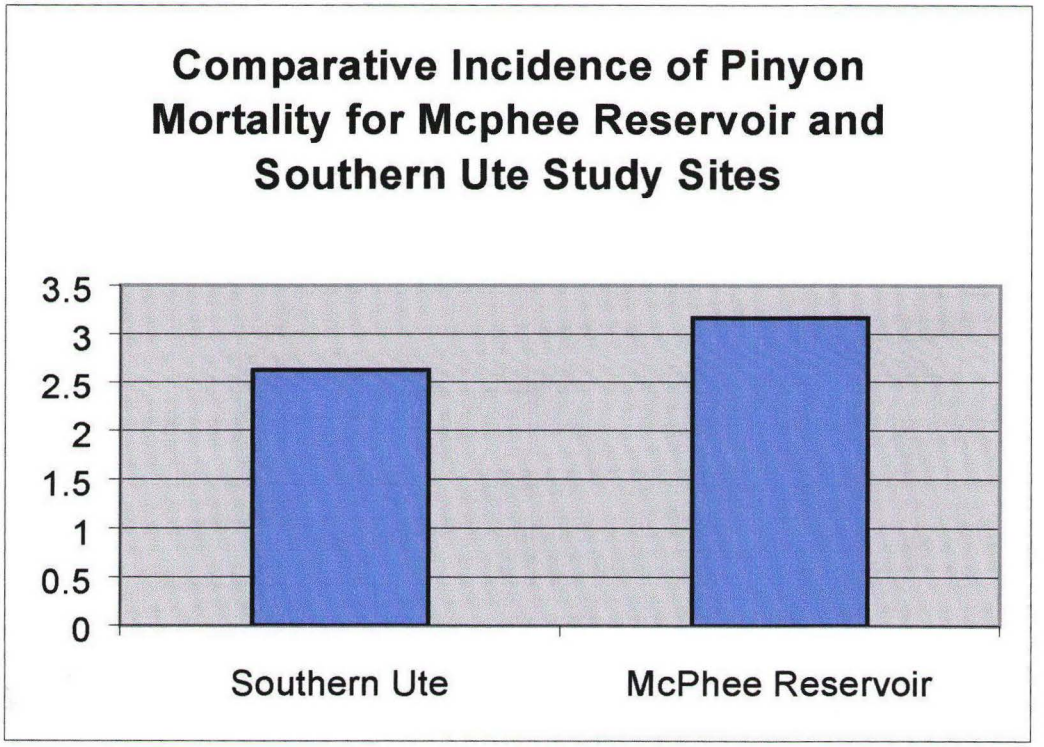
3. Obtain field data. Also during the summer of 1998, field personnel recorded data for 50 half-mile transects located throughout the two areas for which photos were obtained. There were two purposes to this phase of the study: first, incidence of the decline, previously unknown, could be determined based upon the data collected. Second, the locations of mortality sites found in this sample provide the preliminary basis for the model. These transects were placed so that each would fall within a different section, as determined using 7.5 minute USGS quads. The sections sampled were chosen so as to cover the maximum area within the flight zones. The status of the pinyon trees and normal forestry measurements were taken along the transects.

4. Analyze field data. The data from the 1998 field season was compiled and preliminary analysis completed. The data will be entered into a GIS database so that it can be merged with the spatial data relating to site characteristics. This will make possible a preliminary analysis to test for correlation between mortality observed on the ground and underlying site factors.

5. Digitize photos. Over 850 photos were analyzed to identify pinyon mortality by circling with a pen one or more dead trees. Then, photos are being digitized and referenced to lat-long coordinates so they may be overlaid with existing GIS coverages. This process will create GIS coverages that contain spatial data for the entire study area and the associated site data for all sample points.

6. 1999 Field Season. During the 1999 field season, a field crew sampled over 40 mortality sites identified from the infrared photographs. The boundary was traversed with a GPS unit to obtain accurate areas. All dead trees were counted within these mortality sites to determine the relationships between photo interpreted mortality incidence and area affected and the on site determinations.

Results of Field Survey: Figure one.



1. Incidence of pinyon pine mortality was 2-3.5 % of all trees in the sampled areas (Figure 1)
2. Only stem density and tree diameter were significantly related to incidence of Black Stain root disease. Plots where the disease occurred had smaller diameter trees and more of them (Table 1)

Table One: Relationship of tree and site factor and occurrence of black stain root disease in pinyon stands.

Variable	Disease in interval	Mean	Probability> |T|
Tree Diameter(inch)	no	5.36	0.04
	yes	4.86	0.04
Percent slope (%)	no	16.7	0.40
	yes	17.8	0.39
Tree Density (Stems /acre)	no	182.4	0.001
	yes	230.0	0.001

Spatial analysis:

1. The goal of this portion of the study was to determine if aerial photography could detect black stain root disease and Ips bark beetle mortality and distinguish them. This study was also supposed to determine if there were any site or physiographic factors related to the occurrence of mortality using GIS and spatial data analysis.

2. We succeeded in interpreting all photos for mortality by drawing polygons on the photos. Determining cause of death was not attempted since there were so many dead trees and there were no distinct differences noted.

3. We counted the number of green, dying or dead trees within the polygons.

4. We digitized these polygons and bound them together to form 3-4 photo's around each of the 50 field transects.

5. In future studies we plan to:

- Assess the spatial distribution of the polygons
- Determine if there any spatial relationships between slope, aspect, soil conditions, vegetation classification, precipitation and occurrence of the mortality.
- Determine the relationship between on the ground counts of dead trees and the counts taken from the aerial photos.

Conclusions:

- The interpretation of mortality from the infrared photos was feasible, but true color would have worked just as well since only green, red and dead trees could be detected. No initial stressed trees were detected by the photos. The effort was immense and under normal circumstances costs would 2-3 times what we had to spend. We could not determine what pattern of mortality was related to Ips Vs black stain root disease. We would need more ground truth plots related to polygons that fit different patterns of mortality to distinguish mortality causes.

- Digitizing the polygons was probably the hardest activity since one had to find five to 10 known x/y coordinates on digital ortho maps so these scanned polygons could be given a location. This process takes hours for each photo. Starting a survey with GIS/GPS positioned digital data would be a much better system.

- The determination of any spatial relationships and amount of trees impacted etc will be part of future studies building on this study.

The following is an additional summary of this project:

Introduction

Project Objective: To produce a GIS-based landscape scale prediction system for incidence of pinyon decline in Southwest Colorado. The general principles of this hazard-rating model will be applicable, with local modifications, to pinyon/juniper forests throughout the Intermountain West.

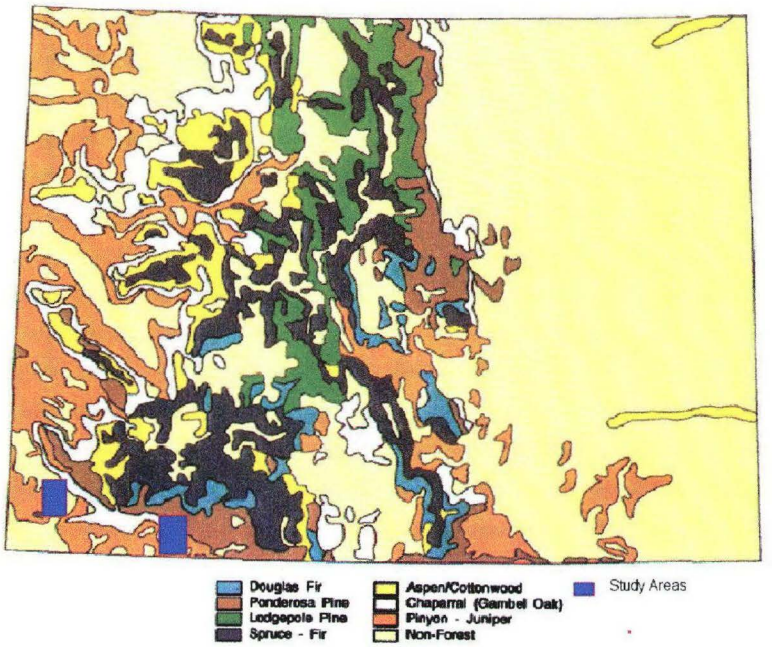
Project Description: Using aerial photography and site visits by field personnel, mortality centers in pinyon pine forests located in the San Juan National Forest and the Southern Ute Reservation in Colorado are being identified and entered into a GIS database along with soil and site characteristics and locations of disturbed areas. Analyzing the data using spatial statistics, a hazard rating system will be developed for pinyon decline in the Southwest.

Justification: In recent years, there have been reports of pinyon pine dying in unprecedented numbers in areas of the Southwest. The chief agents of mortality in these stands have been identified as Black Stain Root Disease (*Leptographium wageneri* var. *wageneri*) and Ips bark beetles (*Ips confusus*), but factors contributing to the susceptibility of pinyon stands to these agents is largely unknown. This hazard-rating system will enable managers of public forests, National Parks and Monuments, county lands, and private holdings to identify high risk areas for pinyon decline and to thereby implement practices to reduce the damage caused by the disease. Pinyon mortality has become a major problem in pinyon/juniper forests of the Intermountain West. It creates areas of mortality, which affect wildlife and biodiversity as well as detract from the value of forested land for recreational and aesthetic purposes. Currently, no tools exist to provide managers with information regarding which areas are at risk.

A few years after this house was built near Dolores, CO, all of the pinyon began to fade and die. Each year, the owner loses a few more trees to black stain root disease. Note the stumps in the foreground; removal of affected trees has failed to avert further loss.

Visitors to Mesa Verde National Park take a break in the "shade" of affected pinyon pine. Detriment to scenic beauty in highly used recreation areas is of great concern to local land managers.

Major Forest Types of Colorado



Forest types of Colorado shown along with the two study regions. Pinyon and its associates account for a full 20% of the forested lands in the state of Colorado. *Reprinted with permission from the Colorado State Forest Service.*

Aerial view of pinyon mortality near Cortez, Colorado.

Materials and Methods

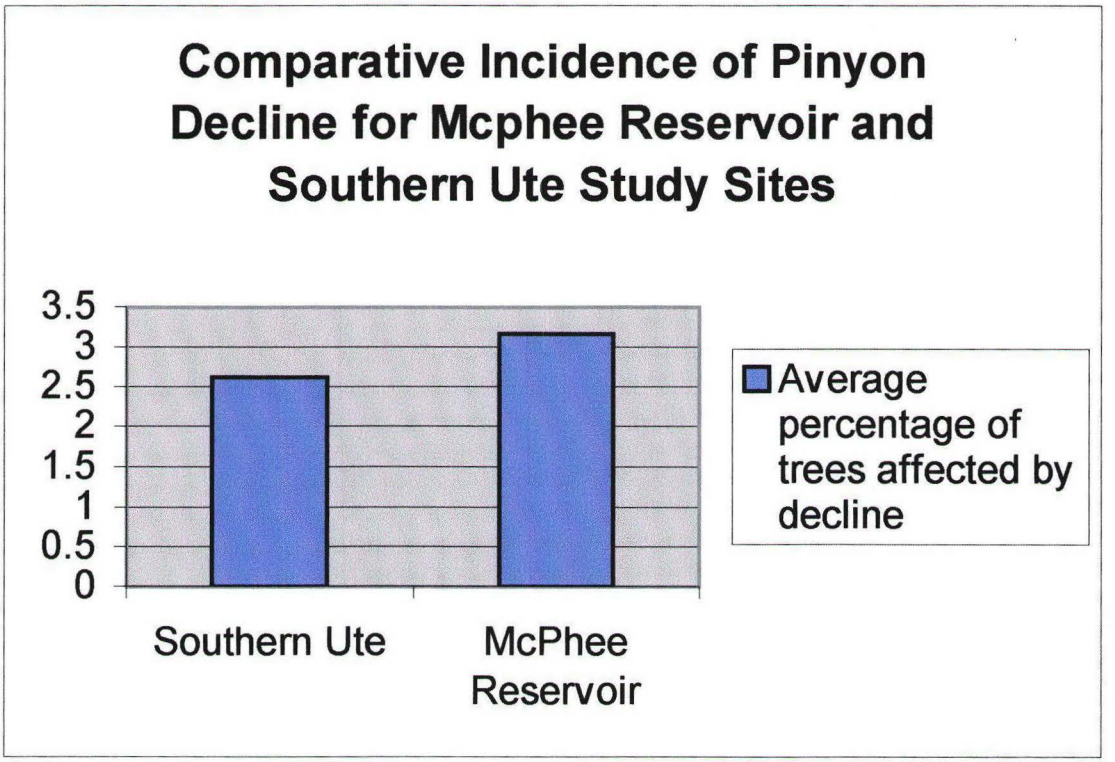
During the 1998 field season, field personnel recorded data for 50 transects located throughout the two study areas. There were two purposes to this phase of the study; first, incidence of the decline, previously unknown, could be determined based upon the data collected. Second, relationships between pinyon mortality and various stand attributes and site characteristics could be determined from this survey, providing the basis for a preliminary model.

These transects were placed so that each would fall within a different section, as determined using 7.5 minute USGS quads. The sections sampled were chosen so as to cover the maximum area within the area for which aerial photography was to be obtained.

Each transect was 66' wide and was comprised of 8 intervals 264' (4 chains) long. All pinyon mortality and causal factors were recorded within each interval, along with site characteristics such as slope, aspect, and cover type. Additionally, a 20th-acre plot was established in each interval to record detailed measurements of trees, both live and dead, including diameter, height, crown radius, and damaging agents.

Results of Field Survey

Characterizing affected stands: Based upon the results of the ground survey performed in 1998, we can infer that affected stands are most likely to contain larger numbers of small diameter trees, have higher total basal area, and have a lower proportion of ground cover comprised of Gambel Oak and varied forbs than unaffected stands.



The data collected in the field study were analyzed to test for significant differences between the observable characteristics of affected and unaffected areas. Additionally, total incidence of mortality as a percentage of the total pinyon component of affected forests was estimated for the two study areas.

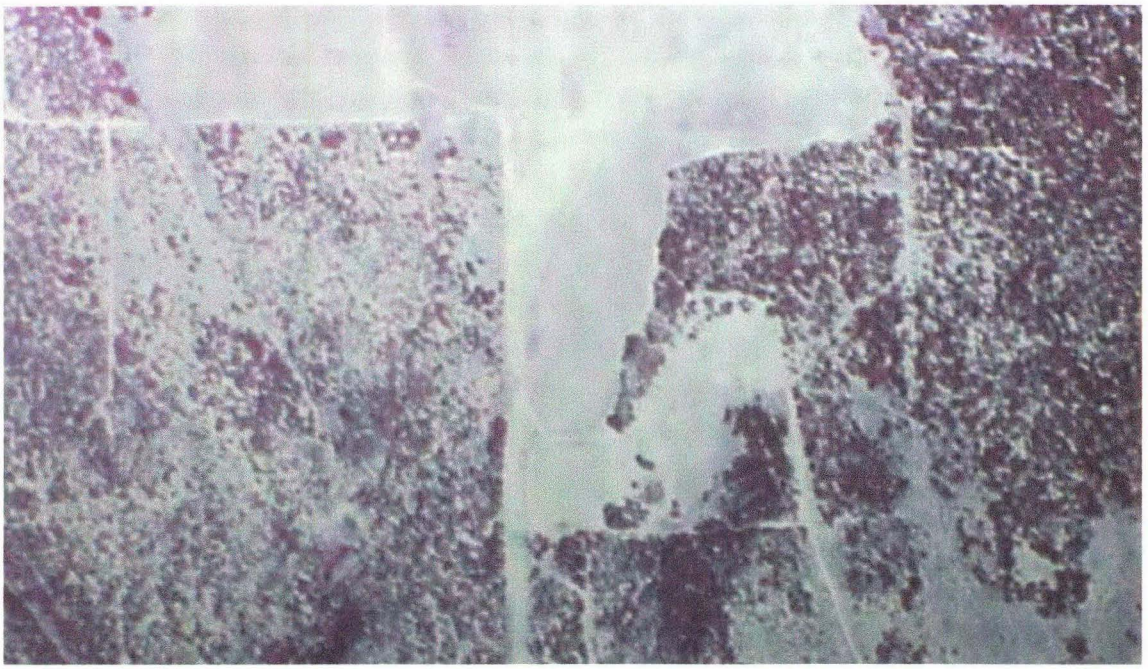
Statistical Results of 1998 Field Survey:

Variable	Disease	Mean	Prob > |T|
Diameter (in.)	Y	4.86	0.0452*
	N	5.36	
Height (in.)	Y	11.1	0.3820
	N	11.5	
Density (#/acre)	Y	299	0.0001*
	N	182	
Crown area (sq.ft./acre)	Y	11786	0.1174
	N	10361	
Pinyon BA (sq.ft/acre)	Y	49.8	0.0001*
	N	33.8	
Slope (%)	Y	17.8	0.3970
	N	16.7	
Gambel oak (% cover)	Y	7.0	0.0221*
	N	9.35	
Forbs (%cover)	Y	1.6	0.0076*
	N	3.0	

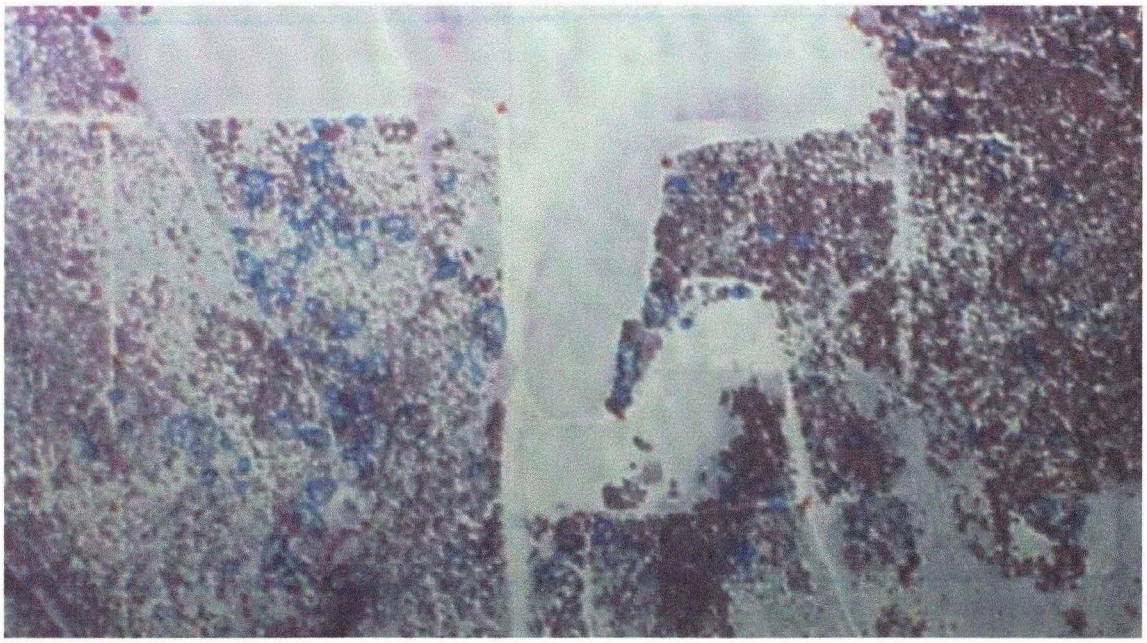
Results of analysis of the data from the 1998 field season. Statistics for transect intervals containing affected trees were compared to those of unaffected intervals. *denotes significance at the 95% level

Analyzing Patterns of Mortality from Aerial Photography

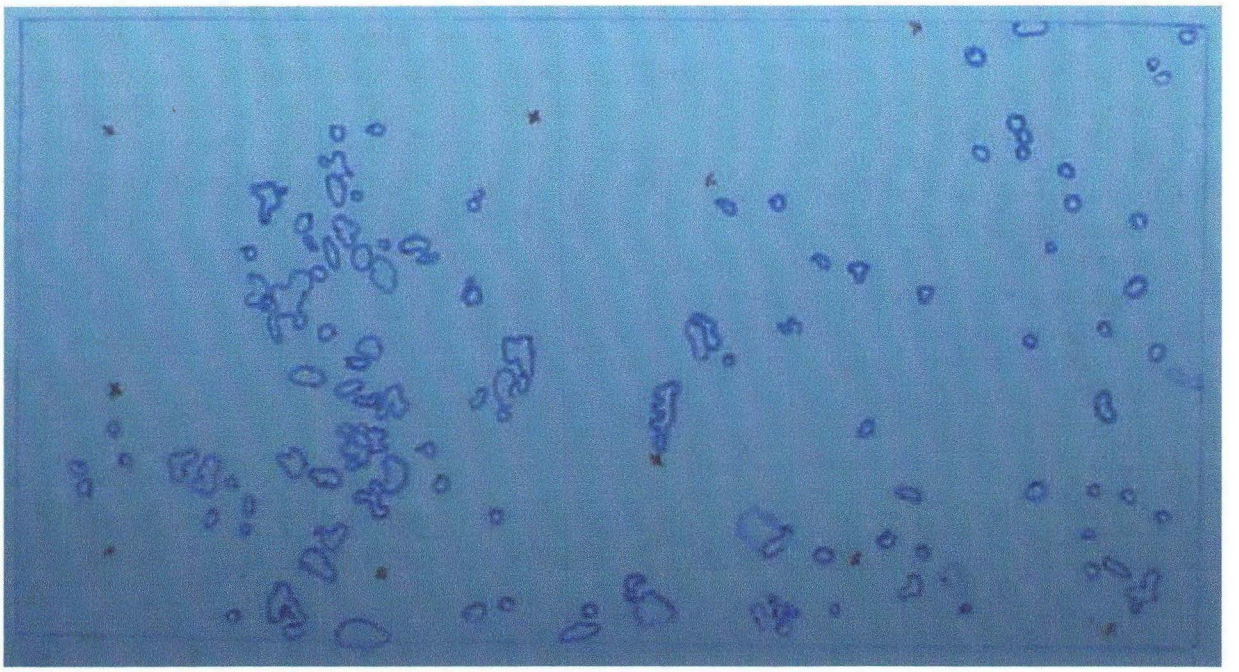
During the summer of 1998, infrared photography at the 1:6000 scale was obtained for both study areas. The images have been manually interpreted by means of a hand lens and/or stereoscope to demark areas of mortality. Interpretation of the photos is performed on a transparency placed over the photo. The transparency is then removed from the photo to be digitized directly via flatbed scanner. Each of these interpreted raster images is geo-referenced using a digital orthographic quad, converted to a vector image using GIS software, and joined with adjacent images.



Infrared photo at 1 : 6000 scale.

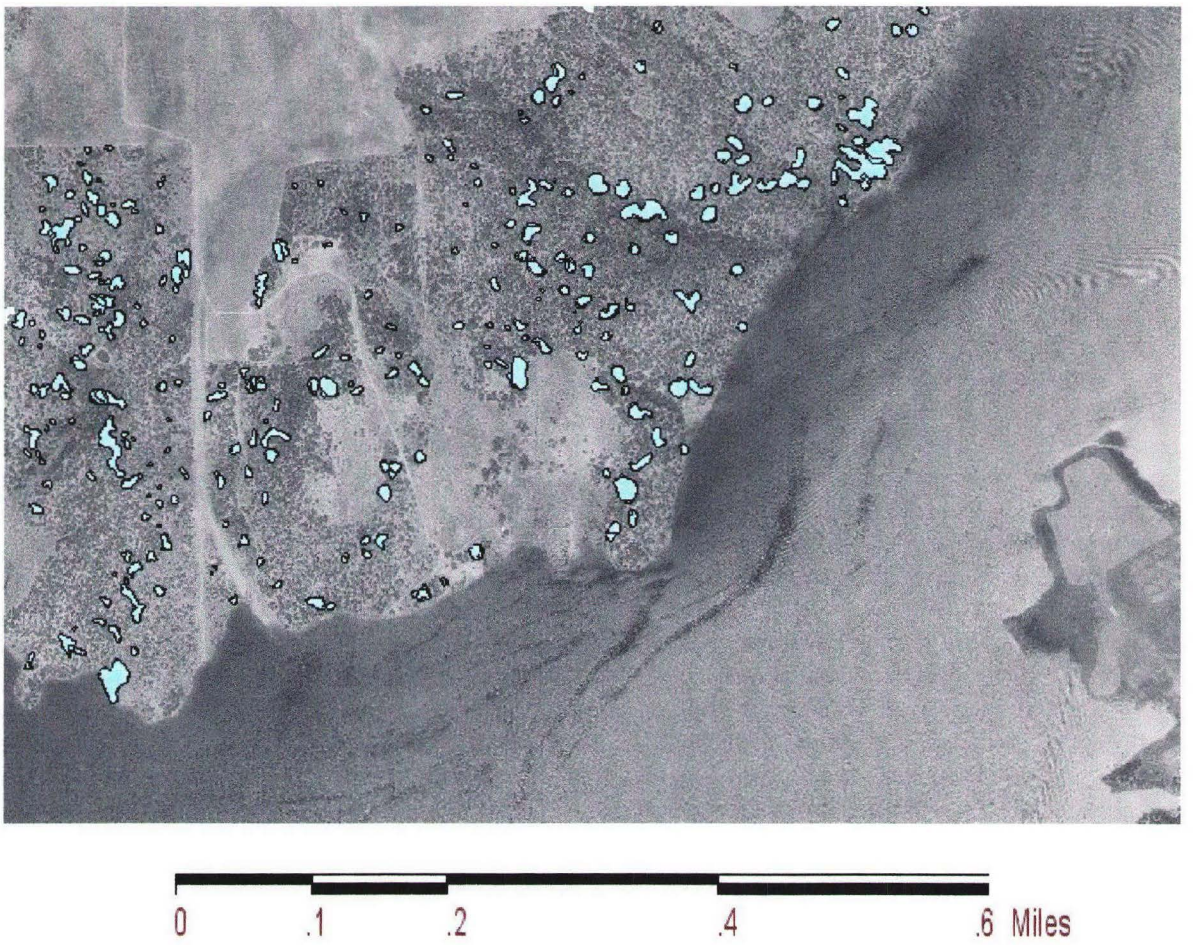


Interpreted photo, showing areas of mortality (in blue) and registration points for geo-referencing (in red).



Areas of mortality digitized into raster format.

Pinyon Mortality: Western Shore of Mcphee Reservoir



A completed mosaic of the pattern of mortality for a small area on the western shore of McPhee Reservoir, derived from 4, 1 : 6000 scale infrared photos. In this diagram, the pattern of mortality is displayed atop the digital orthographic quad that was used to geo-reference the data. The polygons are stored in GIS vector coverage format. Each polygon is associated with a set of entries in the database representing the number of dead, dying, and live crowns within. These spatially explicit data are being used to test for autocorrelation between mortality and the underlying site conditions.

Work remaining

Once all mortality for both study areas has been converted to into GIS coverages, we can test for spatial autocorrelation between pinyon mortality and underlying site characteristics derived from existing databases. USDA Forest Service and BIA Forestry have provided GIS data for both study areas including:

- Soil types
- Vegetation, including both vegetation type and percentage cover
- Digital Elevation Models (DEM) to examine elevation, slope, aspect, and hydrological characteristics of the landscape.

Cooperators

Forest Health Personnel:
Dr. Roy Mask, Entomologist, Forest Health Management, Gunnison, CO.
Dr. Tom Eager, Entomologist, Forest Health Management, Gunnison, CO.
Dr. Jim Worell, Pathologtist, Forest Health Management, Gunnison, CO.

Forest Health Monitoring:
Michelle Frank, Entomologist, Lakewood, CO.

Forest Health Technology Enterprise Team:
Dr. Eric Smith, Biological Statistician

Colorado State University Personnel:
Dr. William R. Jacobi, Professor of Forest and Shade Tree Pathology
Samuel F. Harrison, Graduate Student
Holly Kearns, Graduate Student

Colorado State Forest Service:
Mike Schomaker, Pathologist
Dan Ochocki, District Forester
Jim Hubbard, Head

Southern Ute BIA:
Jim Friedley, Silviculturist

San Juan National Forest:
Dan Green, Forester, Dolores Ranger District
Phil Kemp, Supervisory Forester, Dolores Ranger District
Eric Lindroth, GIS Specialist, Dolores Ranger District

Field data:

Electronic versions of the following data sets were delivered to FHTET in Fort Collins.

1. Field survey of McPhee area 30 transects
2. Field survey of Southern Ute Area 20 transects
3. SCS Soil data associated with the mid point of each interval of a transect
4. Common vegetation data from the San Juan NF associated with the mid point of each interval of a transect

Data Codes for Pinyon Decline Project Summer 1998

Date
Transect Number
Interval
M/P (Mortality Survey/ Plot Survey)
0 = Mortality; dead/dying trees surveyed for entire interval
1 = Plot; all trees surveyed in a $1/20^{th}$ plot representative of the interval at large

Tree Status
0 = Live
1 = Dying, needles faded in color
2 = Recent dead, some needles retained
3 = Older dead, no needles retained
9 = Fire killed

Tree Species
PIED - pinyon pine
JUSP - juniper
PIPO - ponderosa pine

Diameter at root crown in inches (DRC)

Height in feet (Ht)
Only taken for plot survey, not mortality survey

Crown radius in feet (CR)
Measured four times for each tree at 90 degree angles and averaged
only taken for plot survey, not mortality survey

Number of Stems
Number of distinct stems starting at or below 4.5'

Decline Code

0 = live, unaffected by decline agents
1 = symptomatic of black stain root disease, or in direct contact with a black stain disease center, but no positive signs of black stain found
2 = symptomatic of attack by *Ips* bark beetles, but no insects found for positive identification (very rare)
3 = symptomatic of both black stain and *Ips*, but neither found
4 = confirmed black stain tree
5 = confirmed *Ips* tree
6 = both black stain and *Ips* confirmed on tree
9 = unknown cause of mortality

Damage Codes (Dmg1, Dmg2)

All damages are denoted by a two-digit code, followed by a severity rating. The numbers possible for severity ratings differ for different damages, as noted below.

10 = animal damage, severity = 1 to 9, denoting 10% to 90% of tree affected
11 = sapsucker damage, severity = 1 to 9, denoting 10% to 90% of tree affected
21 = *Ips* feeding attack, no galleries observed (no severity rating)
22 = unknown bark beetles (no severity rating)
23 = *Pedioptera* twig beetles (no severity rating)
31 = *Phoradendron* mistletoe on junipers
severity:
1 = <25% of branches affected
2 = 25 – 50% of branches affected
3 = > 50 of branches affected
32 = *Arceuthobium* dwarf mistletoe on pinyon
severity : Hawksworth rating system, 1 – 6
95 = broken off top

Disturbance Codes (Dstrb1, Dstrb2, Dstrb3)

1 = interval within 50m of road
2 = interval has signs of firewood cutting
3 = interval has signs grazing by livestock
4 = interval has signs heavy grazing by wildlife
5 = interval has signs fire
6 = interval contains a two-track access trail

Slope percentage (Slope %)

Averaged over the length of the interval

Aspect

1 = North
8 = Northwest (clockwise progression)

Topography (Topo)

1 = convex slope
2 = concave slope
3 = even slope

Cover types (Cover%1, Cover %2, Cover %3)

Each cover is denoted by a two-digit code, followed by a third digit representing percent of ground covered. For example, 112 represents 20% cover of *Quercus gambelii*.

11 = *Quercus gambelii*
12 = Serviceberry (*Amalanchier*)
19 = Miscellaneous shrubs
21 = *Mahonia repens*
22 = Sagebrush (*Artemisia tridentata*)
29 = Miscellaneous forbs
39 = Miscellaneous grasses

Azimuth

Compass direction from beginning of interval to end.

Soil Data Codes

Data codes for soil information obtained from soil survey data.

Transect Number
Interval ID
Interval Number
Soil ID (Sri mus ym)
Available water capacity (AWC): Weighted means for 0-12 inches
Mbd: Weighted means for 0-12 inches
Organic Percent (Organic %): Weighted means for 0-12 inches
pH: Weighted means for 0-12 inches
Cation Exhange: Weighted means for 0-12 inches
Permeability: Weighted means for 0-12 inches
Available water capacity (AWC): Weighted means for 0-24 inches
Mbd: Weighted means for 0-24 inches
Organic Percent (Organic %): Weighted means for 0-24 inches
pH: Weighted means for 0-24 inches
Cation Exhange: Weighted means for 0-24 inches
Permeability: Weighted means for 0-24 inches
Available water capacity (AWC): Weighted means for 0-36 inches
Mbd: Weighted means for 0-36 inches
Organic Percent (Organic %): Weighted means for 0-36 inches
pH: Weighted means for 0-36 inches
Cation Exhange: Weighted means for 0-36 inches
Permeability: Weighted means for 0-36 inches

Data codes for San Juan National Forest common vegetation data can be obtained from that forest.

The first few lines of each data set are given on the following pages.

McPhee Resevoir Area Data

Date	Transect Number	Page Number	Interval Number	M/P	Tree Status	Tree Species	DRC "	Ht '	CR '	Number of Stems	Decline Code	Dmg 1	Dmg 2	Dstrb 1	Dstrb 2	Dstrb 3	Slope %	Aspect	Topo	Cover % 1	Cover % 2	Cover % 3	Cover % 4	Azimuth
72498	31	1 of 6	1	0													40	3	2	192				180
72498	31	1 of 6																						
72498	31	1 of 6	1	1	0	JUSP	18.5	24	6.5	1	0						40	3	2	192				
72498	31	1 of 6	1	1	0	PIED	4.5	11	3.5	2	0						40	3	2	192				
72498	31	1 of 6	1	1	0	PIED	4	8	2	2	0						40	3	2	192				

Southern Ute Transects

Date	Transect Number	Page Number	Interval Number	M/P	Tree Status	Tree Species	DRC "	Ht '	CR '	Number of Stems	Decline Code	Dmg 1	Dmg 2	Dstrb 1	Dstrb 2	Dstrb 3	Slope %	Aspect	Topo	Cover % 1	Cover % 2	Cover % 3	Cover % 4	Azimuth
52098	1	1 of 6	1	0	2	PIED	9			1	9			3			15	8	3	111				156
52098	1	1 of 6	1	0	3	PIED	9			1	9			3			15	8	3	111				156
52098	1	1 of 6	1	0	3	PIED	4			1	9			3			15	8	3	111				156
52098	1	1 of 6	1	0	3	PIED	9			2	9			3			15	8	3	111				156
52098	1	1 of 6	1	0	3	PIED	21.5			1	9			3			15	8	3	111				156
52098	1	1 of 6																						
52098	1	1 of 6	1	1	0	PIED	2.5	4		1	0			3			15	8	3	111				156
52098	1	1 of 6	1	1	0	PIED	1	3		1	0			3			15	8	3	111				156
52098	1	1 of 6	1	1	0	PIED	1	3		1	0			3			15	8	3	111				156

Soil data

Transect Number	Interval ID	Interval Number	Soil ID Sri_musym	AWC 12	Mbd 12	Organic 12	pH 12	Cation Exchange 12	Permiability 12
1	1	1	527	0.066	0.674375	0.410416667	3.43375	4.916666667	0.37125
1	2	2	527	0.066	0.674375	0.410416667	3.43375	4.916666667	0.37125
1	3	3	527	0.066	0.674375	0.410416667	3.43375	4.916666667	0.37125
1	4	4	527	0.066	0.674375	0.410416667	3.43375	4.916666667	0.37125
1	5	5	527	0.066	0.674375	0.410416667	3.43375	4.916666667	0.37125
1	6	6	527	0.066	0.674375	0.410416667	3.43375	4.916666667	0.37125
1	7	7	802	0.032125	0.591875	0.71875	5.795	24.16666667	0.384
1	8	8	802	0.032125	0.591875	0.71875	5.795	24.16666667	0.384
2	9	8	860	0.056666667	0.426875	0.36875	6.49	21.0625	0.177333333
Transect Number	**Interval ID**	**Interval Number**	**Soil ID Sri_musym**	**AWC 24**	**Mbd 24**	**Organic 24**	**pH 24**	**Cation Exchange 24**	**Permiability 24**
1	1	1	527	0.060458333	0.718854167	0.352083333	2.422708333	4.255208333	0.254583333
1	2	2	527	0.060458333	0.718854167	0.352083333	2.422708333	4.255208333	0.254583333
1	3	3	527	0.060458333	0.718854167	0.352083333	2.422708333	4.255208333	0.254583333
1	4	4	527	0.060458333	0.718854167	0.352083333	2.422708333	4.255208333	0.254583333
1	5	5	527	0.060458333	0.718854167	0.352083333	2.422708333	4.255208333	0.254583333
1	6	6	527	0.060458333	0.718854167	0.352083333	2.422708333	4.255208333	0.254583333
1	7	7	802	0.0466875	0.6871875	0.575	5.795	25.80208333	0.358
1	8	8	802	0.0466875	0.6871875	0.575	5.795	25.80208333	0.358
2	9	8	860	0.101208333	0.7590625	0.503125	6.515	23.90625	0.410666667
Transect Number	**Interval ID**	**Interval Number**	**Soil ID Sri_musym**	**AWC 36**	**Mbd 36**	**Organic 36**	**pH 36**	**Cation Exchange 36**	**Permiability 36**
1	1	1	527	0.058361111	0.707013889	0.304166667	1.930138889	3.878472222	0.206388889
1	2	2	527	0.058361111	0.707013889	0.304166667	1.930138889	3.878472222	0.206388889
1	3	3	527	0.058361111	0.707013889	0.304166667	1.930138889	3.878472222	0.206388889
1	4	4	527	0.058361111	0.707013889	0.304166667	1.930138889	3.878472222	0.206388889
1	5	5	527	0.058361111	0.707013889	0.304166667	1.930138889	3.878472222	0.206388889
1	6	6	527	0.058361111	0.707013889	0.304166667	1.930138889	3.878472222	0.206388889
1	7	7	802	0.054625	0.715625	0.483333333	5.795	26.40972222	0.284666667
1	8	8	802	0.054625	0.715625	0.483333333	5.795	26.40972222	0.284666667
2	9	8	860	0.110555556	0.826458333	0.522916667	6.390694444	23.47916667	0.485111111

Common Vegetation data

Transect Number	Interval ID	Interval Number	Lf gsc	Species Mix	Species 1	Species 2	Species 3	% 1	% 2	% 3	Cover type	Cover %	Size class	Horiz diversity	Tree Cover %	Shrub Cover %	Grass Cover %	Forb Cover %	Barren Cover %	Water Cover %	Tree species
1	1	1	F					0	0	0	F	60		C	5	0	5	60	30	0	JUOS:PIED
1	2	2	F					0	0	0	F	60		C	5	0	5	60	30	0	JUOS:PIED
1	3	3	T	PIED:JUNIP	PIED	JUNIP		15	14	0	T239	29	L	C	29	38	12	8	12	0	PIED:JUNIP
1	4	4	T	PIED:JUNIP	PIED	JUNIP		15	14	0	T239	29	L	C	29	38	12	8	12	0	PIED:JUNIP
1	5	5	T	PIED:JUNIP	PIED	JUNIP		15	14	0	T239	29	L	C	29	38	12	8	12	0	PIED:JUNIP
1	6	6	T	PIED:JUNIP	PIED	JUNIP		15	14	0	T239	29	L	C	29	38	12	8	12	0	PIED:JUNIP
1	7	7	T	PIED:JUNIP	PIED	JUNIP		15	14	0	T239	29	L	C	29	38	12	8	12	0	PIED:JUNIP
1	8	8	G					0	0	0	G	35		C	18	5	35	24	19	0	PIED:JUNIP
2	9	8	G					0	0	0	G	31		C	7	18	31	28	16	0	PIED:JUNIP